13 AUGUST 1980 (FOUO 7/80) 1 OF 1

JPRS L/9250

13 August 1980

East Europe Report

SCIENTIFIC AFFAIRS

(FOUO 7/80)

FBIS FOREIGN BROADCAST INFORMATION SERVICE

FOR OFFICIAL USE ONLY

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300020022-2

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

For further information on report content call (703) 351-3060.

JPRS L/9250

13 August 1980

EAST EUROPE REPORT
SCIENTIFIC AFFAIRS

(FOUO 7/80)

CONTENTS

CZECHOSLOVAKIA

UDC 621. 397.676
UDC 621.396.677.5:621.218.134

FERRITE ANTENNA FOR MAGION SATELLITE DESCRIBED

Prague SLABOPROUDY OBZOR in Czech Apr 80 pp 157-160

[Article by Ivan Charvat, Institute of Geophysics, Czechoslovak Academy of Sciences, Prague: "The MAGION Satellite's Ferrite Antenna for a Frequency Range of 0.1 to 16 kHz"]

[Text] An important part of the experimental program for the Czechoslovak MAGION satellite was the study of very low frequency electric and magnetic fields in the ionosphere. A ferrite antenna developed at the Institute of Geophysics, Czechoslovak Academy of Sciences, in Prague was used to receive one component of the magnetic field. This paper describes the design and function of the antenna. The author also describes problems of the antenna's design and measurement of its parameters.

1. Introduction

A special ferrite antenna was developed by the Institute of Geophysics, Czechoslovak Academy of Sciences, for receiving very low frequency magentic fields on the MAGION satellite. The antenna and preamplifier form a functionally inseparable whole, the magnetic sensor, whose capabilities were defined by the experimental program itself.

The required capabilities of the magentic sensor were:

1. Use for broadband reception of one component of the magentic field in the frequency range of 0.1-16 kHz.

2. Constant amplitude characteristics over almost the entire frequency transmission range during excitation by a constant magnetic field.

3. Threshold sensitivity of sensor better than $1 \cdot 10^{-5} \gamma \, Hz^{-1/2}$ in a frequency range from 2 to 16 kHz.

4. Dynamic range of signal amplitude 80 dB.

5. Mechanical resistance to shock during launching of the satellite and reliable operation under space conditions.

2. Description of the Ferrite Antenna's Design

The complete magnetic antenna is a cylinder 280 mm long and 30 mm in diameter. The cylindrical ferrite core is 9.8 mm in diameter and 280 mm long. It is made from material with a permeability of $\mu = 600$. The brittle ferrite is wrapped in laminate. The 22,000-turn antenna is wound with Cu2T wire with a nominal diameter of 0.063 mm. In order to suppress unwanted capacitance and to obtain a higher characteristic resonance frequency for the antenna, the antenna winding is made of 13 self-supporting cemented coils wound on thin-walled laminate tubes in such a way that there is an air gap between coils and between the winding and the core. Beside the antenna winding is cemented a 100-turn feedback coil.

The ferrite core and the winding are housed in a laminate cylinder. The gilded exterior surface of the cylinder is ribbed and acts as an electrostatic screen. At the same time, because of the favorable radiative parameters of gold, the surface of the tube also acts as a passive heat regulator. The preamplifier is located inside the antenna cylinder. A schematic of the connection between the antenna and the feedback loops is shown in Fig. 1.

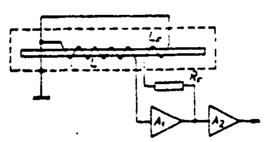

Fig. 1. Diagram of connection of antenna and feedback circuits.

Key: R_F: Feedback resistance; L, L_F: Antenna winding and feedback coil; A_1, A_2: first and second preamplifier stages.

3. Electrical and Magnetic Parameters of the Antenna

The electromotive force induced in one turn of the antenna winding is

$$e_k = -S \frac{\delta B_k}{\partial t}, \qquad (1)$$

where S is the oriented cross section of the core and B_k is the magnetic induction in the core at the surface of the k-th turn.

The magnetic induction drops from the center toward the ends of the core as a result of demagnetization. If the core is magnetized longitudinally in the direction of the rotational axis by a homognenous magnetic field H, the magnetic induction at the surface of the k-th turn will be

$$B_k = \mu_k B_0, \qquad (2)$$

where $B_0 = \mu_0 H$, μ_0 is the permeability of free space and μ_k is the relative permeability in the core at the surface of the k-th turn. If the exciting magnetic field is homogeneous, coincident with the antenna axis and harmonic, so that its induction in a vacuum can be written in the form $B_0 = Be^{-j\omega t}$, the electromotive force induced in the entire antenna winding of N turns will be, according to equation (1),

$$e = j\omega SB \sum_{k=1}^{N} \mu_k. \qquad (3)$$

The relative permeability μ_c in the center of the core, where the magnetic induction is at a maximum, depends only on the intrinsic permeability of the core material and its shape.

If we introduce the factor

$$F = \frac{\bar{\mu}}{\mu_c}, \qquad (4)$$

where $\bar{\mu}$ is the arithmetic mean of the set of elements μ_k, we obtain (3) in the form

$$e = j\mu_c SNF\omega B. \qquad (5)$$

The effective permeability of the antenna is the product $\mu_{ef} = \mu_c F$. We introduce two other parameters: the effective area A_{ef} of the loop, and the antenna constant K

$$A_{ef} = \mu_{ef} SN, \qquad (6)$$

$$K = 2\pi A_{ef} = \frac{e}{fB}, \qquad (7)$$

where f is the frequency.

The dimensions of K are generally $\mu V \gamma^{-1} Hz^{-1}$ ($\gamma = 10^{-9}T$). The main characteristics of the magnetic sensor can be elucidated by analyzing the equivalent circuit of the magentic antenna and preamplifier. This circuit is shown in Fig. 2. By the usual approach we obtain the voltage response of the antenna (without feedback) with a homogeneous sinusoidal field

$$U = \frac{j\omega A_{ef} B}{\alpha}, \qquad (8)$$

where

$$\alpha = \left(\frac{R}{R_i} + 1 - \omega^2 CL\right) + j\omega\left(\frac{L}{R_i} + RC\right) \qquad \text{and } C = C_a + C_i.$$

By introducing the transfer coefficient

$$\xi = \frac{j\omega A_{ef}}{\alpha} \qquad (9)$$

this equation can be rewritten in the form

$$U = \xi B. \tag{10}$$

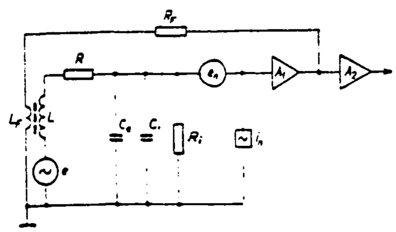

Fig. 2. Equivalent circuit of the magnetic antenna and preamplifier.

Key: L, C_a: inductance and capacitance of antenna winding
R: effective loss resistance of antenna
C_i, R_i: input capacitance and resistance of preamplifier
e_n, i_n: idealized voltage and current source of preamplifier noise
A_1, A_2: first and second stages of preamplifier with gain of A_1 and A_2
L_F, R_F: inductance of feedback coil and feedback resistance

The coefficient ξ is a function only of frequency and temperature for this antenna. Thus the voltage in the antenna is directly proportional to the exciting field at a given frequency. For the antenna response to a noise-type magnetic field we have an equation analogous to (10):

$$\left(\frac{dU^2}{df}\right)^{1/2} = \xi b, \tag{11}$$

where b is the spectral induction of the magnetic field or its component along the antenna axis. The dimensions of b are $\mathrm{THz}^{-1/2}$. For the internal noise of the antenna and preamplifier we have

$$n^2 = 4k\Theta \operatorname{Re} Z + (i_n Z)^2 + e_n^2, \tag{12}$$

where k is the Boltzmann constant, Θ is the absolute temperature and V is the impedance of the input circuit. The threshold sensitivity of the circuit can be calculated from the defining equation

$$n = \xi b \tag{13}$$

by substituting the expression for n from equation (12):

$$b = \frac{1}{A_a\omega}\left\{4k\Theta\left[R\left(\frac{R}{R_i}+1\right)+\frac{(\omega L)^2}{R_i}\right]+ \right.$$
$$\left. + (e_n\alpha)^2 + i_n^2[R^2+(\omega L)^2]\right\}^{1/2}. \tag{14}$$

In deriving these equations we started from the simple equivalent circuit of Fig. 1. This equivalent circuit expresses the behavior of the actual circuit very well. It cannot be used to explain the existence of secondary resonances of the antenna, which however are outside the transmitted band.

4. Measured Parameters of the Flying Model of the Magnetic Sensor

Antenna: $N = 22,000$, $S = 75.4$ mm^2; $\mu = 600$; $\mu_{ef} = 200$; $F = 0.97$; $A_{ef} = 300$ m^2; $K = 2 \mu V \gamma^{-1} Hz^{-1}$; $L = 55H$; $C_a = 8$ pF; R_s 5.75 kΩ; $f_R = 7.6$ kHz (R_s is the ohmic resistance of the antenna winding and f_r is its characteristic resonance frequency).

Feedback coil: $N_F = 100$; $R_F = 68$ kΩ.

Preamplifier: $R_i = 130$ MΩ ; $C_i = 3$pF; $A_1 = 30$ dB.

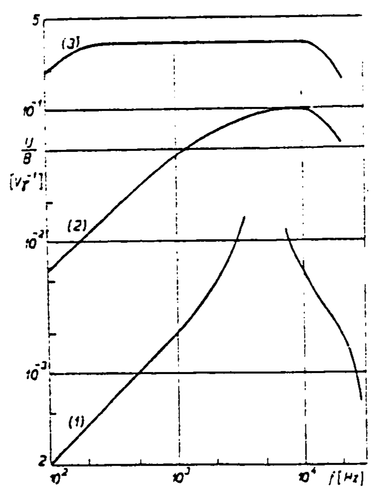

Fig. 3. Transmission characteristics.

Key: (1): Antenna potential without feedback
(2): Output of first preamplifier stage
(3): Output of second preamplifier stage; complete connection of magnetic sensor.

Fig. 3 shows three characteristics: the frequency dependences of the output voltage of the antenna and the first and second stages of the preamplifier when the antenna is excited by a unit magnetic field. In the conditions under which we measured the threshold sensitivity of the sensor, the external interference b_1 was not negligible, and accordingly the measurement obtained only the value of $b_2 = (b^2 + b_I^2)^{1/2}$, as is explained below in the description of the method of measuring the threshold sensitivity. The frequency dependence curve of b_2 is given in Fig. 4.

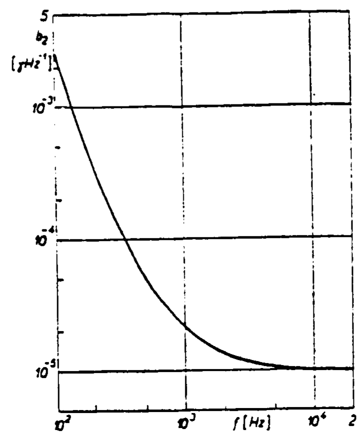

Fig. 4. Measured threshold sensitivity of magnetic sensor: $b_2 = (b^2 + b_1^2)^{1/2}$

Key: b: threshold sensitivity of magnetic sensor
b_2: level of external interference

5. Measurement of the Electrical and Magnetic Parameters of the Magnetic Sensor

We used the apparatus diagrammed in Fig.5 to measure the characteristic parameters of the magnetic sensor. The antenna was artificially excited by a known homogeneous field from the exciter coil. We used a selective nanovoltmeter with a bandpass filter with a width defined by 40 dB/octave. Measurements of the output voltage were supplemented by phase measurements. But with the usual level of manmade interference fields, we could make only a few unselective measurements with strong artificial excitation of the antenna. To measure the parameters of the antenna itself we used a preamplifier with $R_i \approx 1 \cdot 10^{11}$ ohm, $C_i \approx 3$ pF and gain $A = 1$. Owing to its great sensitivity, the threshold sensitivity of the sensor had to be measured in a location with a low interference field level using a battery-powered device.

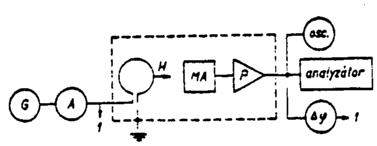

Fig. 5. Measurement of parameters of magnetic antenna

Key: G: tone generator; A: milliammeter; H: exciter loop; MA: magentic antenna; P: preamplifier; osc.: oscilloscope; Δq: phase meter; analyzator: analyzer

All contacts were shielded, and the antenna, exciter coil and preamplifier were electrostatically and magnetically shielded by means of four sheet steel boxes.

5.1 Measurement of the intrinsic capacitance and inductance of the magnetic antenna

The intrinsic capacitance and inductance of the antenna were derived from the measured characteristic resonance frequency of the antenna using pairs of measurements with and without an added parallel capacitance $C_p > 100(C_a + C_1)$. In both cases we have $\omega^2 = L(C_a + C_p)$ at resonance. In the first case, in practice we can use the following equation to calculate the inductance:

$$L = \frac{4\pi^2}{C_p} f_1^2 \qquad (15)$$

while in the second case, using the known inductance of the antenna we calculate its intrinsic capacitance from the equation

$$C_a = \frac{4\pi^2}{L} f_2^2, \qquad (16)$$

where f_1 and f_2 are the respective resonance frequencies.

5.2 Measurement of the effective loss resistance

The effective loss resistance R can be determined from the measured voltage response of the antenna at resonance $(U/B)_r$. If we use a preamplifier with an FET input transistor, we have $R_i \gg R$ and $R_i \gg L/RC$, and R can be calculated from the equation

$$R = \frac{A_{ef}}{(U/B)_r C}, \qquad (17)$$

which we obtain by rearranging (8). By adding a parallel capacitance to the antenna we can decrease its resonance frequency, after which we can determine R from the measured antenna response by using equation (17). We used this approach to determine the frequency dependence of R (Fig. 6).

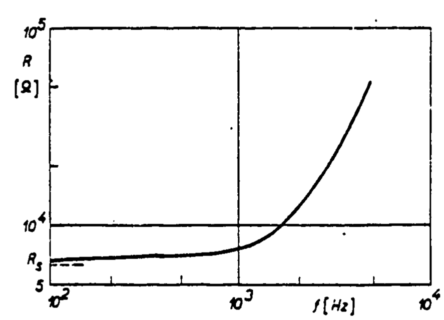

Fig. 6. Frequency dependence of the effective loss resistance of the antenna

5.3 Measurement of the threshold sensitivity of the sensor

During artificial excitation of the antenna, the preamplifier input voltage is composed of three contributions: the antenna response to the artificial monotone harmonic excitation by a field B, the antenna response to the external interference field b_1, and the intrinsic noise n of the sensor. In view of equations (10) and (11) we have

$$\frac{dU^2}{df} = \xi^2(b_1^2 + B^2) + n^2. \qquad (18)$$

In the present case, the output signal passes through the narrow bandpass filter Δf of the analyzer, and accordingly the effective voltage at the preamplifier output will have the value

$$V = [\xi^2(b_1^2\,\Delta f + B^2) + n^2\,\Delta f]^{1/2}. \qquad (19)$$

Measurement of the spectral sensitivity of the sensor at a selected frequency consisted of two steps. The values of the effective voltage V_1 and V_0 were read from the analyzer (connected to the output of the first stage of the preamplifier), during artificial excitation of the antenna. In the first case the artificial excitation was so strong that $V_1 > 10V_0$. Under such conditions we can ignore the contribution of the external interference and internal noise of the sensor in equation (19), so that we have

$$V_1 = A\xi B, \qquad (20)$$

where A is the preamplifier gain. In the second step, $B = 0$, and accordingly

$$V_0 = A[(\xi^2 b_1^2 + n^2)\,\Delta f]^{1/2}. \qquad (21)$$

If in this equation we substitute for n according to the definition (13) of threshold sensitivity and the value of $A\xi$ from equation (20), we obtain after rearrangement

$$(b_1^2 + b^2)^{1/2} = \frac{V_0 B}{V_1(\Delta f)^{1/2}}. \qquad (22)$$

From the measured values of V_1 and V_0 and the known values Δf and B we can calculate the size of the sum $b_1^2 + b^2$. We then know the threshold sensitivity b of the magnetic sensor which we sought, provided that the interference from external fields is negligible or its magnitude is known from other measurements. The threshold sensitivity of the magnetic antenna itself can be obtained by "subtracting" the internal noise n_0 of the preamplifier:

$$b_a = \left[b^2 - \left(\frac{n_0}{\xi}\right)^2\right]^{1/2}. \qquad (23)$$

In measuring the internal noise of the preamplifier, it must be in the same operating regime as when connected to the antenna. Accordingly we simulate the antenna by means of a resistance whose magnitude corresponds to the effective resistance of the antenna at the frequency in question. A graph of the measured threshold sensitivity of the magnetic sensor, i.e. of the value $b_2 = (b^2 + b_1^2)^{1/2}$ is given in Fig. 4.

6. Design of the Magnetic Antenna

The main aim in developing the antenna was to achieve maximum antenna sensitivity while maintaining a favorable transmission characteristic, which gives the frequency response of the preamplifier with a constant exciting field. In functional terms the antenna and preamplifier form an inseparable whole. Accordingly it was necessary to develop them together.

The particular main orientation in developing the amplifier is given by a theoretical analysis of equation (14). If we ignore the internal noise of the preamplifier ($e_n = i_n = 0$) we obtain for the threshold sensitivity of the antenna itself

$$b_a = \frac{1}{A_{ef}\omega}\left\{4k\Theta\left[R\left(\frac{R}{R_i}+1\right)+\frac{(L\omega)^2}{R_i}\right]\right\}^{1/2}. \quad (24)$$

In addition it is clear that

$$b_a > b_a^L, \quad (25)$$

where

$$b_a^L = \frac{p}{A_{ef}}\frac{L}{R_i^{1/2}} \quad \text{and} \quad p = (4k\Theta)^{1/2}.$$

The quantity b_a^L accordingly places a lower limit on the threshold sensitivity. The magnitude of b_a^L can be effectively decreased only by choosing a high input resistance for the preamplifier. For example, when using an FET transistor, $R_i \approx 10^{11}$ ohms, and the term b_a^L can be totally neglected. In our case, the preamplifier input has a low-noise model KC809 bipolar transistor with $R_i = 1.3 \cdot 10^8$ ohms and a corresponding value for b_a^L of $1.9 \cdot 10^{-6} \gamma\,\mathrm{Hz}^{-1/2}$. Accordingly, for the antenna to be sufficiently sensitive, the input resistance of the preamplifier must be greater than $R_i = 10^8$ ohms. But since we have $R_i \gg R$, equation (24) can be replaced by the approximate relationship

$$b_a = \frac{p}{A_{ef}}\left(\frac{R}{\omega^2}+\frac{L^2}{R_i}\right)^{1/2}. \quad (26)$$

The two terms in the equation compete with each other. The first term dominates at low frequencies, when

$$b_a \doteq b_a^R = \frac{p}{A_{ef}}\frac{R}{\omega^2},$$

but this falls as the frequency increases, so that in the upper part of our frequency range the sensitivity is determined by the constant term b_a^L. As an example, Fig. 7 gives the range of threshold sensitivities calculated from equation (24).

The large size of the parameter A_{ef} leads to a high sensitivity not only of the antenna itself but also of the magnetic sensor, as follows from equation (14), since as A_{ef} increases so does the ratio of the antenna response to the internal noise of the preamplifier. The quantity $A_{ef} = \mu_c SNF$ depends on the choice of a core and the nature of the antenna winding. Metal or ferrite cores are used depending on the frequency range in which the antenna is to be used. The metal core has a much greater permeability than a ferrite core, but at higher frequencies it has large losses. Accordingly, these cores are used in the range below 1 kHz, while ferrite cores are used above 10 kHz. The choice of material presents a problem in the zone between 1 and 10 1Hz. For a rod-shaped ferrite core with a given initial permeability, the product $\mu_c S$ is a function of the shape of the core.

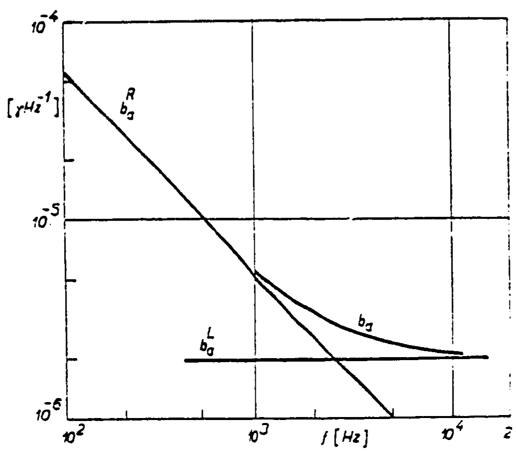

Fig. 7. Threshold sensitivity of the magnetic antenna.

$$b_a = \frac{1}{A_{ef}\omega}\left\{4k\Theta\left[R\left(\frac{R}{R_i}+1\right)+\frac{(\omega L)^2}{R_i}\right]\right\}^{1/2},$$

$$b_a^R = \frac{R(4k\Theta)^{1/2}}{A_{ef}\omega}, \qquad b_a^L = \frac{L}{A_{ef}}\left(\frac{4k\Theta}{R_i}\right)^{1/2},$$

$$A_{ef} = 3.2 \cdot 10^{-7}\ \mathrm{V}\,\gamma^{-1}\,\mathrm{Hz}^{-1},\ R = 6 \cdot 10^3\ \Omega,\ R_i = 1.3 \cdot 10^4\ \Omega$$

$$L = 55\ \mathrm{H},\ \Theta = 300\ ^\circ\mathrm{K},\ k = 1.38 \cdot 10^{-23}\ \mathrm{J}\ ^\circ\mathrm{K}.$$

A graphic example of this dependence for a material with $\mu = 2000$ is given in Fig. 8. The increase in the value of $\mu_c S$ as dimensions are increased is subject to limits. At the same time, the parasitic feedback capacitance and losses in the core and the antenna winding increase. The product NF shows a continually slowing rate of increase as the winding begins to extend toward the end of the core, because F decreases. Accordingly further lengthening of the winding ceases to be expedient. An increase in the number of turns leads to an undesirable drop in the characteristic resonance frequency of the antenna as a result of increasing inductance (see Fig. 9) and to the occurrence of marked secondary resonances, which place an upper limit on the working band of the antenna. In addition losses in the windings and coil increase and the probability of shorting between turns rises. For our antenna, the choice of a ferrite core was dictated by the antenna dimensions. The number of turns followed empirically from the need to maintain the lower transmission limit. The falling branch of the transmission characteristic near the upper bound of the transmission band shows a sharply defined minimum, which could not be shifted very much toward higher frequencies by other design changes than a decrease in the number of turns.

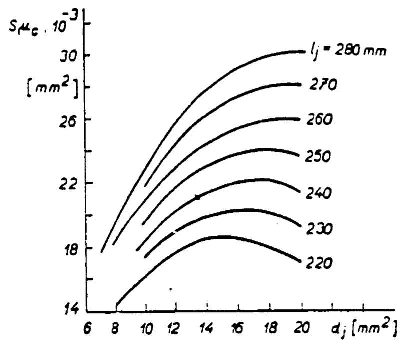

Fig. 8. Dependence of the product $S\ _c$ on core dimensions (l_j and d_j are the length and diameter of the core)

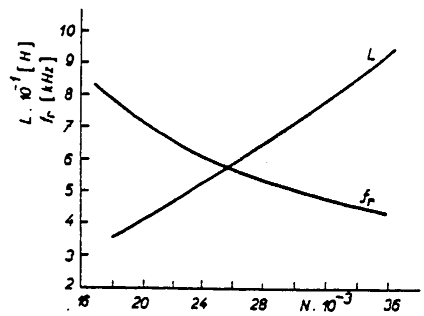

Fig. 9.

The input circuit of the preamplifier must have a large input resistance and low capacitance and should operate with minimal internal noise. The internal noise n_0 of the preamplifier clearly limits the threshold sensitivity of the input circuit. For an antenna with a transmission coefficient ξ we clearly have $b > n_0/\xi$. For example, for $\xi = 5 \cdot 10^{-3} V\gamma^{-1}$ and $n_0 = 5 \cdot 10^{-9}$ $VHz^{-1/2}$, b is greater than $1 \cdot 10^{-6} \gamma\, Hz^{-1/2}$.

The frequency characteristic of the antenna response to a constant magnetic field has a typical shape (Fig. 3). High reception sensitivity can be achieved only by having the characteristic resonance of the antenna lie inside the reception band. The area where the response is directly proportional to the frequency passes to a resonance peak, after which the characteristic falls to a sharp minimum, which should lie at the upper boundary of the transmission band. A number of secondary resonances follow. For physical interpretation of the measurements it is desirable that the transfer function of the receiving system depend only on the level of the exciting signal and not on its frequency. We achieved the desired shape of the transmission characteristic by introducing inductive feedback and frequency-variable amplification in the second stage of the preamplifier. The inductive feedback is obtained by means of a feedback coil wound on the antenna core and connected through a regulating series circuit to the output of the first stage of the preamplifier. In the frequency band between 0.1 and 20 kHz the voltage at the output of the first stage of the preamplifier is in phase with the voltage in the antenna. If the feedback components are poorly chosen there may be spontaneous frequency swings in the circuit. Here an important role is playe by the phase ratio between the exciting field and the feedback. Accordingly it is advantageous to choose a large value for the gain of the preamplifier first stage so that the regulating feedback resistance R_F will be large compared with the inductance L_F of the feedback coil. Thus there will not be an unwanted phase shift of the excitation current by the feedback coil so that it is behind the voltage of the preamplifier first stage output. In our case, we had $A_1 = 30$ dB, $R_F = 68$ kΩ, $L_F = 20$ mH. The preamplifier second stage has a frequency-variable gain of 10-40 dB.

Better experimental results could be achieved by using antennas specialized for a narrower section of the frequency band to be received. Further basic progress in the quality of magnetic sensors of the type described here will depend on the development of new core materials and new low-noise preamplifier circuits.

7. Conclusion

The MAGION satellite was launched in 14 November 1978. The experimental data obtained by means of the magnetic sensor described above over many months' operation of the satellite confirmed the good quality of the sensor. As a result, a similar antenna manufactured by the Institute of Geophysics, Czechoslovak Academy of Sciences was installed on the Interkosmos 19 satellite, launched in 27 February 1979. It appears that the new-type magnetic sensor may replace the loop antennas that hitherto have been used on the Interkosmos series satellites.

8480
CSO: 2402

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300020022-2

CZECHOSLOVAKIA

CSSR METALLURGICAL INDUSTRY ASSESSED

Prague HUTNIK in Czech May 80 No 5 pp 161-163

[Editorial: "Thirty-Five Years of Free Czechoslovakia and Development of the Czechoslovak Metallurgical Industry"]

[Text] In May of this year we are noting the 35th anniversary of the end of World War II and the liberation of Czechoslovakia by the Soviet army. Due to the Nazi occupation and war operations, the Czechoslovak economy was very seriously disrupted in the wake of the war. In transportation, 72 percent of railroad lines were rendered impassable; 50 percent of locomotives, 75 percent of freight cars and two-thirds of passenger cars, 50 percent of buses and two-thirds of trucks were destroyed. Many houses were damaged, the currency was depreciated, supplies of raw and industrial materials were reduced almost to the zero level, and available supplies did not meet even the most basic needs of the population. Industrial production in 1945 amounted to only 50 percent of production in 1937. Only 584,000 tons of pig iron, 959,000 tons of steel, 685,000 tons of rolled material and 85,000 tons of tubes were produced in 1945, approximately one-third of prewar production.

Approximately 70 percent of industry and all banks and insurance companies were nationalized by the decrees of 28 October 1945. By the end of 1946, the most serious consequences of the war were removed and key sections of the national economy were revived. Production in some industrial sectors reached as much as 80 percent of the prewar production volume in 1946. In comparison with 1945, production of pig iron increased 375,000 tons, steel by 600,000 tons, rolled material by 469,000 tons and tubes by 55,000 tons in 1946.

The Eighth CPCZ Congress approved as the main line of economic policy the plan of economic and social rehabilitation, and liquidation of consequences of the Nazi occupation which was spelled out in detail in the two-year plan of the Czechoslovak national economy for the 1947-1948 period. The targets of the two-year plan were essentially met.

The February victory of the Czechoslovak working people in 1948 paved the way to the socialist development of Czechoslovakia. Following the nationalization of all Czechoslovak industry, national enterprises were set up and metallurgical plants were incorporated into the huge industrial combine centrally managed according to a plan in order to promote further development of the entire Czechoslovak industrial production.

The main goals of the general line of building socialism in Czechoslovakia which was approved by the Ninth CPCZ Congress in May 1949 were to increase production in metallurgical and engineering industries by 83 percent during the period of the First Five-Year Plan over the results achieved by the two-year plan, increase labor productivity, reduce production costs and to minimize the waste in consumption of raw materials, fuels and energy. Another key document related to further development of metallurgy in Czechoslovakia was the government resolution of 1951 on the measures aimed at improving the work of the metallurgical industry, full utilization of its capacities, construction of additional metallurgical plants and improving material conditions of workers in the metallurgical industry.

In comparison with 1948, Czechoslovak engineering production increased 300 percent, production of pig iron by 69 percent, steel by 67 percent and rolled material by 73 percent by the end of the last year of the First Five-Year Plan that is 1953. Metallurgical and engineering production continued to dynamically increase during the subsequent periods of economic development of Czechoslovakia.

More than Kcs 34 billion were spent on the construction of metallurgical plants during the period of the second to fourth five-year plans. The newly constructed New Metallurgical Works of Klement Gottwald [NHKG] metallurgical combine in Ostrava-Kuncice for example produced more steel in 1965 than the entire prewar Czechoslovakia combined.

Apart from NHKG, East Slovak Iron Works [VSZ] Kosice, Orava Ferroalloy Plants [OFZ] Istebne and Iron Works Veseli in Moravia were constructed, and extensive reconstructions were undertaken and production increased in other metallurgical enterprises, primarily in Trinec Iron Works of the Great October Socialist Revolution [TZVRSR] Trinec.

The construction of VSZ Kosice and OFZ Istebne and modernization of the Sverma Iron Works in Podbrezova substantially increased the share of the Slovak metallurgical industry in the entire Czechoslovak metallurgical production from 8.6 percent in 1965 to 22.4 percent in 1975. VSZ Kosice, for example, accounts for 31 percent of pig iron, 27 percent of steel and 25 percent of rolled material in total Czechoslovak production today.

During the first half of the Fifth Five-Year Plan, beginnings were made for the construction of a new plant for production of high-grade steels in Poldi SONP [United Steel Works national enterprise] Kladno as well as for modernization and reconstruction of both old plants. Major investment projects were carried out also in Tube Rolling Mills and Iron Works Chomutov and other metallurgical enterprises.

Manufacture of basic metallurgical products increased approximately 3.5 times in the CSSR from 1965 to the end of 1975, and the CSSR thus became one of the biggest producers of steel in the world. In absolute quantity of produced steel, the CSSR was 10th in the world and in relative terms (approximately 1,000 kilograms of steel per capita) second in the world right after Belgium and Luxembourg and ahead of Japan in 1976. The overall standard consumption of fuels per ton of steel produced declined from 38.2 GJ [gigajoules] to approximately 28.0 GJ or approximately 26.5 percent between 1965 and 1975. Standard coke consumption in production of pig iron declined from 739 kg/t to 514 kg/t or by more than 30 percent during the same period.

Ferrometallurgy accounted for 9.9 percent of gross production of Czechoslovak industry as a whole in 1975 and occupied third place right after the engineering and food industries. It accounted for 7.7 percent of the labor force, in fourth place right after the engineering, textile and food industries. The share of the metallurgical sector in the total value of basic assets of Czechoslovak industry amounted to 10.5 percent which placed the metallurgical industry in fourth place after the engineering industry, industry of fuels and production of electricity and energy.

In contrast to the previous periods, a relative slowdown of the growth rate of metallurgical production is planned for the Sixth Five-Year Plan. In regard to rolled material, for example, the growth rate of the production volume is 10 percent lower and in the case of steel tubes 15 percent lower than during the Fifth Five-Year Plan. In production of steel and metallurgical products, however, a significant qualitative change took place in the past years of the Sixth Five-Year Plan by starting production of high-grade steel for the so-called "tube program" and for increased production of tubes and components for nuclear power plants. The increased share of converted steel by its increased production in VSZ Kosice must also be regarded as very important. Another increase in production of converter steel will be achieved after the oxygen-converter steel plant in TZVRSR at Trinec is put into operation during the Seventh Five-Year Plan.

In addition to the blue-collar workers, innovators and members of youth associations, it was our progressive technical intelligentsia which played an important role in the development of the metallurgical industry in Czechoslovakia during the past 35 years. It is necessary to realize that our metallurgical plants were predominantly managed by German technicians and engineers until 1945 and that, due to the war operations on our territory, many valuable technical and technological documents were destroyed. There were only few Czech and Slovak technicians in our metallurgical plants after the liberation of Czechoslovakia. The CPCZ offered the working class the opportunity to form from its ranks a new socialist intelligentsia. That was the birth of a large body of politically minded and professionally competent technicians and engineers and managerial personnel who contributed to the restoration and construction of the Czechoslovak metallurgical basis.

We must emphasize also the great contribution of blue-collar workers and technicians of Czechoslovak engineering enterprises who successfully carried out the postwar construction of metallurgical coking plants, blast furnaces, steel works and rolling mills as well as the modernization of existing metallurgical plants and enterprises.

The CSSR is an inland state which, apart from coal suitable for coking, did not and does not have iron ore containing raw materials in the necessary quantity on its territory. The rehabilitation and development of our ferrous metallurgy after 1945, therefore, involved major changes in supply of iron ore raw materials from abroad. The only correct orientation which provided our ferrous metallurgy with a guaranteed, reliable raw materials basis at the economically advantageous prices was the signing of long-term agreements on delivery of ores with the Soviet Union. Imports of iron ores from the USSR for the Czechoslovak metallurgical industry have continuously increased since 1946. At the present time, Soviet ores, concentrates and pellets fill approximately 85 percent of total Czechoslovak needs for production of pig iron. By October 1977, the total volume of iron ores imported from the Soviet Union by the CSSR since 1946 amounted to 200 million tons.

Very important for our national economy was Czechoslovakia's joining the ranks of CEMA member states in 1949 where Czechoslovak metallurgy actively participated and participates to an ever-increasing degree in the development of the economies of the entire community.

In connection with securing of the necessary supply of metal for the development of Czechoslovak metallurgical industry, it is also necessary to emphasize the important role of scrap steel from domestic sources which has gradually become one of the basic raw materials sources of supply for production of steel and covers more than one-third of the needs for production of crude steel in the CSSR at the present time. The Scrap Metal Industry supplied the Czechoslovak metallurgical enterprises with 50 million tons of this valuable raw material by the end of 1978.

Scrap ferrous and nonferrous metal has become increasingly important for our national economy.

The 14th plenary session of the CPCZ Central Committee in December 1979, therefore, stressed the need of enacting measures for better management of scrap metal, of better organization of its collection and of introducing a strict system of management of metals in the entire Czechoslovak national economy.

For further development of Czechoslovak metallurgy during the Seventh Five-Year Plan and subsequent period, it is necessary to take into account that further quantitative and qualitative development of the production basis of modern metallurgy requires big investments in all countries of the world at the present time. In contrast to the previous periods, the replacement of live labor by modern equipment has become substantially more expensive. While the replacement of one worker in ferrous metallurgy required an investment of approximately Kcs 500,000 in 1975, these costs have approximately doubled to quadrupled by now.

The qualitative development of Czechoslovak metallurgical production, on which attention should be primarily focused during the next period, should be promoted exclusively in those areas of metallurgical production which, from the national economic point of view, will reduce consumption of metal-bearing raw materials, energy and labor force directly in metallurgical production due to the fact that higher quality and bigger assortment of metallurgical products will make it possible to reduce the demands of user sectors for metal and also to increase the use value of engineering and other products both for the domestic market and exports.

The resolution passed by the meeting of economic and political activists in Prague on 28 February 1980 which was attended by the minister of metallurgy and heavy engineering, general managers of VHJ [economic production units], enterprise managers, chairmen of CPCZ and CPSL enterprise and factory committees, chairmen of ROH [Revolutionary Trade Union Movement] factory committees, chairmen of economic and other organizations supervised by FMHTS [Federal Ministry of Metallurgy and Heavy Engineering] tates that the implementation of the tasks of the last year of the Sixth Five-Year Plan makes it imperative to focus attention primarily on the key problems of the plan. To achieve individual plan objectives it is necessary to enact specific, pertinent and controllable measures designed primarily:

--to stabilize the outputs of the metallurgical complex and also material consumption including fuels and energy; to achieve reliable operations of coking plants, blast furnaces and all other metallurgical aggregates;

--in mining and dressing of ores, to make most effective use of existing capacities and experimental equipment for processing of tetraedrite raw materials, collective and wolfram concentrates;

--in engineering, the planned production increase must strictly adhere to the inputs limited by the plan and their potential increase must be ruled out in advance; to emphatically enforce the anti-import measures, rapidly increase the deliveries of products now in short supply and to increase labor productivity;

--production must be used primarily for accomplishing the export tasks in the territorial structure and with the effect anticipated by the state plan of development. The production structure must adapt, to the maximum possible degree, to the potential increase, and higher quality, reliability, prompt deliveries and efficient merchandising must contribute to achieving the highest possible foreign prices for exported goods. A very high dynamics in exports is to be achieved by heavy engineering (complete industrial plants) primarily in relation to the socialist countries--including a substantial increase in differential indicators. The export plan for the nonsocialist countries is to be regarded as closed and steps must be taken, in cooperation with the foreign trade organizations, to broaden the scope of custommade products and particularly to raise selling prices;

--on the basis of results of supplier-customer negotiations, to make significant progress in the unconditional coordination of relations between the increase in final production and products made by the complementary sectors within the economic production unit, within FMHTS on the one hand and enterprises of FMVS [Federal Ministry of General Engineering], CSR Ministry of Industry (chemical, consumer industries) or SSR Ministry of Industry on the other.

--in domestic deliveries, to lay emphasis on compliance with the planned structure of deliveries for individual categories of investment projects: In the first place those tasks must be met which are designated as social priorities; capacities must be put into operation within the deadlines specified by the plan; the prescribed structure and assortment must also be strictly observed in complementary shipments, in the deliveries of spare parts and supply of products for the domestic market;

--the previously formulated priorities for the fuel-power complex and transportation remain in full effect for the deliveries for capital investment. Equal importance must be attached to the deliveries for general and medium-size repairs of blast furnaces, coking ovens and other important metallurgical production units. The measures of capacity and systems nature now in effect must be strictly enforced in the deliveries of spare parts;

--in the expansion and modernization of the production technical basis, it is imperative to insist on meeting the criteria of rapid returns and savings of both live and materialized labor, on promoting exports and carrying out of planned structural changes aimed at the dynamic increase in capacities of complementary sectors and engineering metallurgy. Efforts must be made not to increase, but to reduce the number of jobs, and to eliminate obsolete equipment;

--in carrying out capital investment projects within the specified limits, to implement also the state target programs calling for reduced consumption of metals, fuels and energy, and modernization of the production technical basis even where these limits cover other central needs;

--the area of technical progress must ensure the anticipated relative savings of fuels and energy amounting to 455,000 tons of standard fuel, relative savings of ferrous metals exceeding 165,000 tons and of nonferrous metals exceeding 2,600 tons. The plans of comprehensive socialist rationalization must achieve a substantial part of the planned reduction of labor involved in production and planned savings of materials. It is necessary to formulate progressive standards of standard consumption of fuels and energy for the basic metallurgical products, to elaborate a program for the elimination of energy losses and to continue in the implementation of economy measures in consumption of crude oil products.

The meeting of economic and political activists made all general managers and managers of enterprises and other organizations of the FMHTS production basis, including political workers, responsible for the implementation of measures listed above.

In evaluating the development of Czechoslovak metallurgy in the last 35 years and implementation of demanding tasks, it is necessary to state that the workers in the Czechoslovak metallurgical plants carried out all tasks assigned to them in an exemplary way and on time during the entire period since the liberation of our fatherland by the Soviet army, and by its diligent work and initiative implemented and will implement also in the future the still topical words uttered by Comrade Klement Gottwald at the Ninth CPCZ Congress on 25 May 1949:

"We must carry out and fulfill not only quantitatively, but also qualitatively the economic plan in all sectors of our national economy. Our nationalized industry must produce more, better and at reduced costs."

10501
CSO: 2402

END